United States Patent [19]

Chivers

[11] **4,068,348**

[45] **Jan. 17, 1978**

[54] **FULLY CONCEALED DOOR HINGE**

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[73] Assignee: **Southern Tool Mfg. Co., Inc.**, Winston-Salem, N.C.

[21] Appl. No.: **678,567**

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[51] **Int. Cl.**[2] **E05D 3/06**

[52] **U.S. Cl.** **16/129**; 16/166; 16/179; 16/164

[58] **Field of Search** 16/166, 129, 130, 131, 16/179, 164

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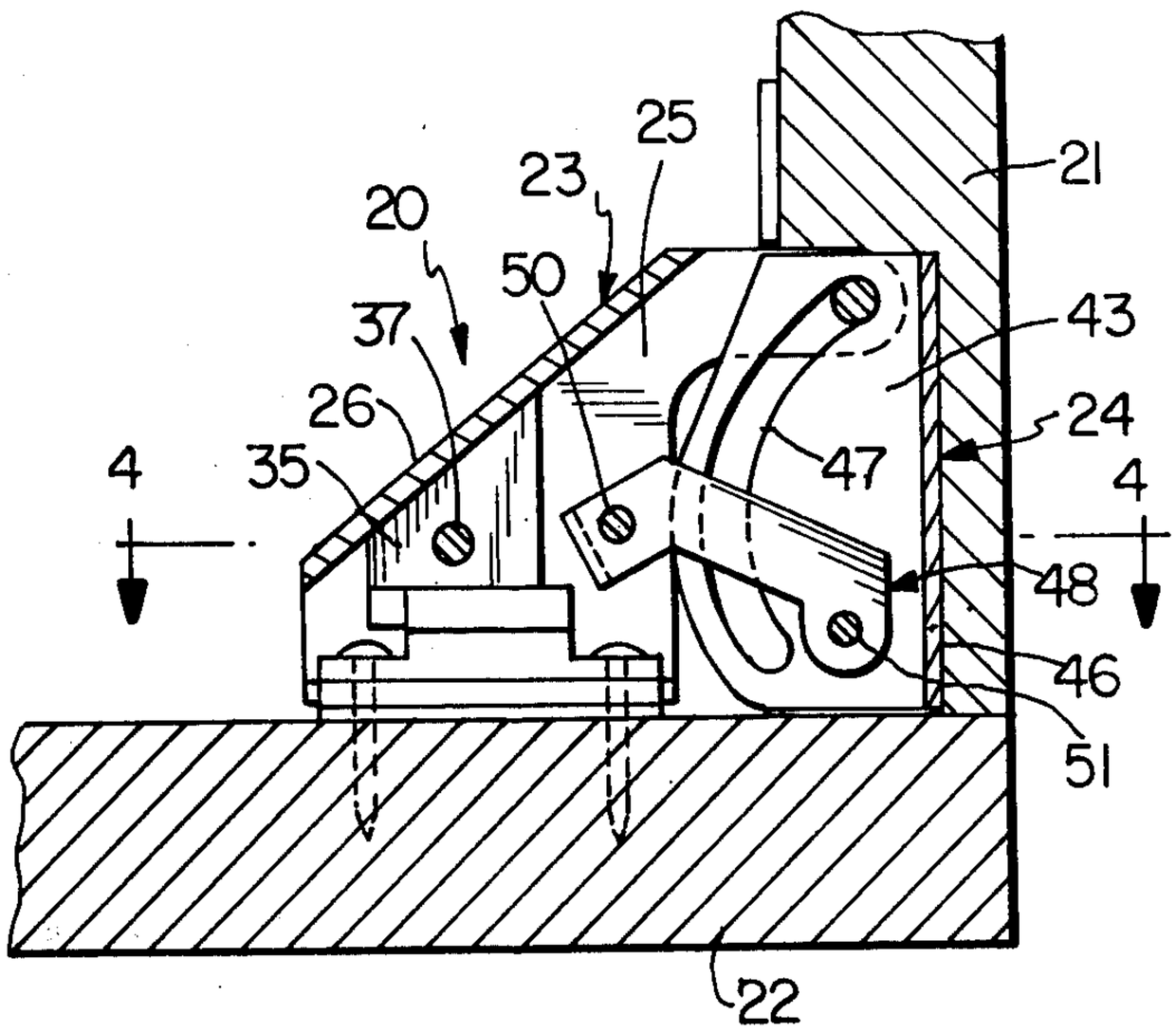
Primary Examiner—Andrew V. Kundrat
Attorney, Agent, or Firm—Dowell & Dowell

[57] **ABSTRACT**

A hinge apparatus for furniture and cabinets which is not visible when the door is closed and which includes linkages associated with a control slot for causing the door to follow a definite rationally chosen path during the opening and closing motion of the door as well as the positioning of the door in a desired location relative to the fixed structure with which it is associated.

3 Claims, 21 Drawing Figures



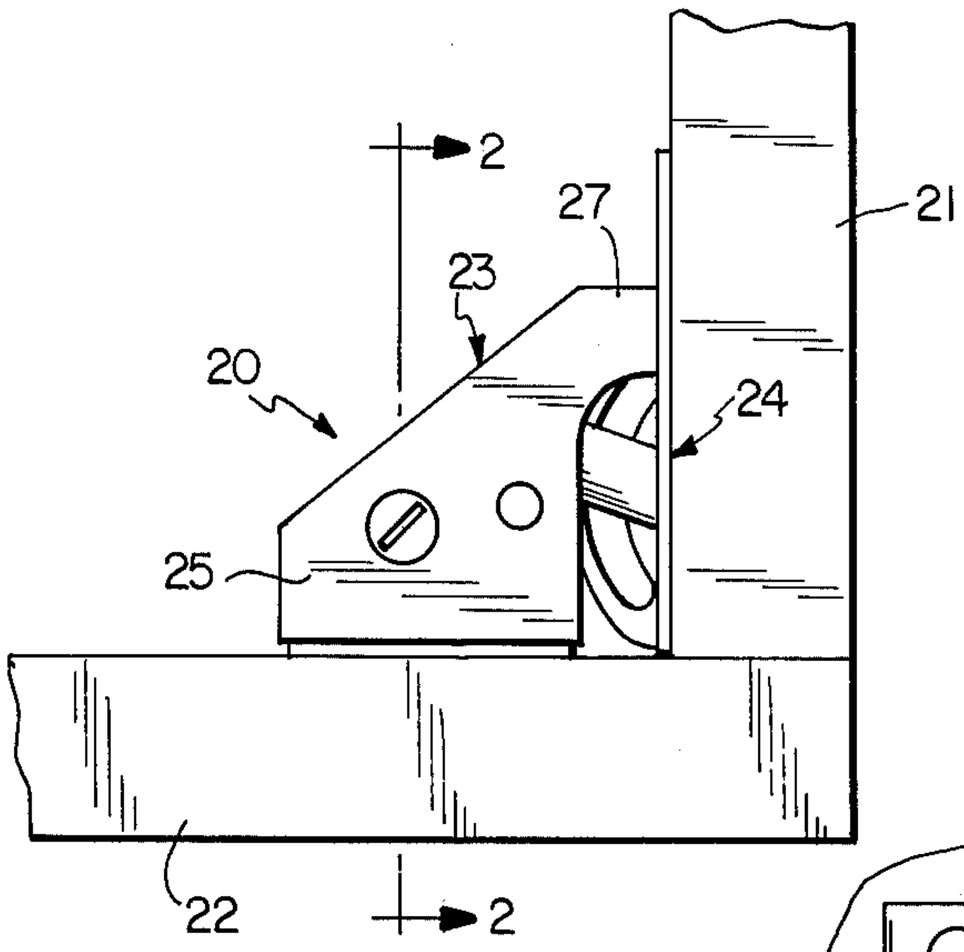


FIG. 1

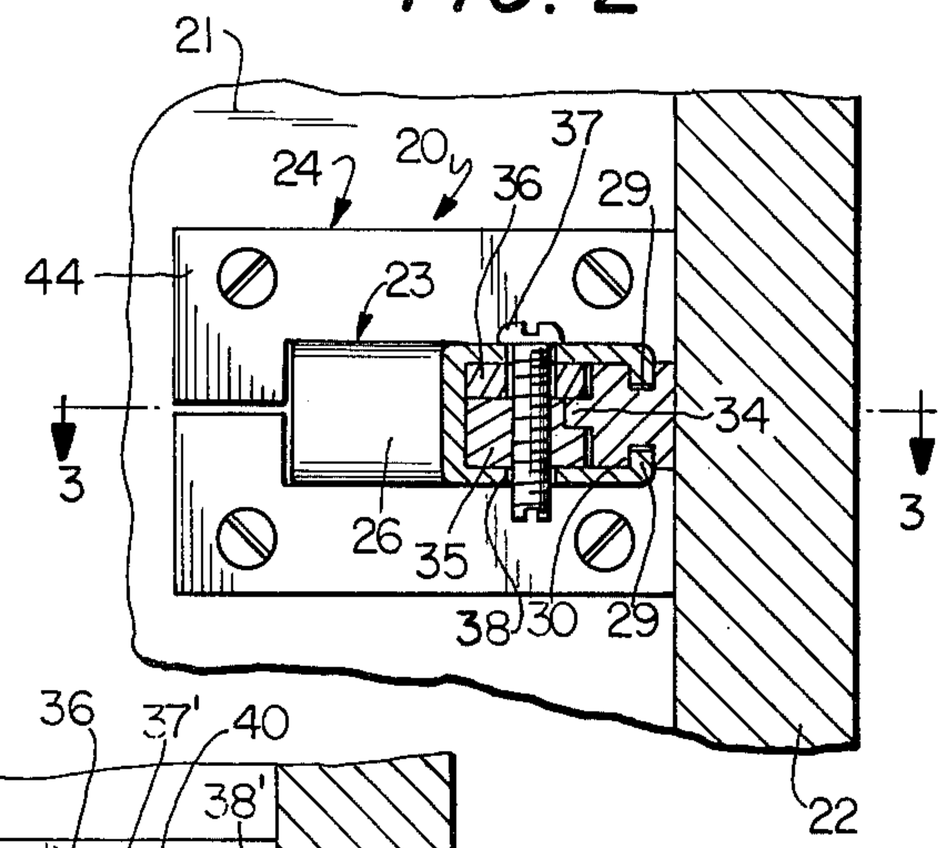


FIG. 2

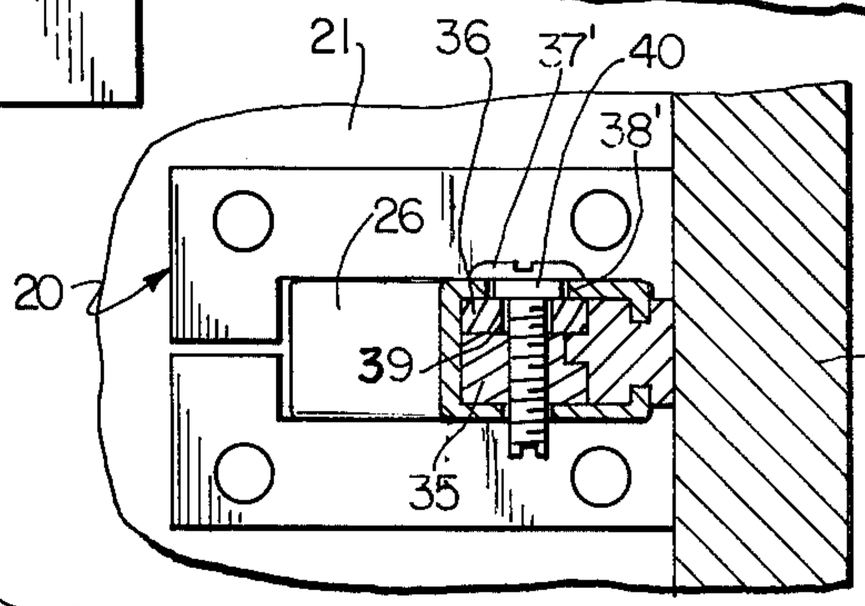


FIG. 5

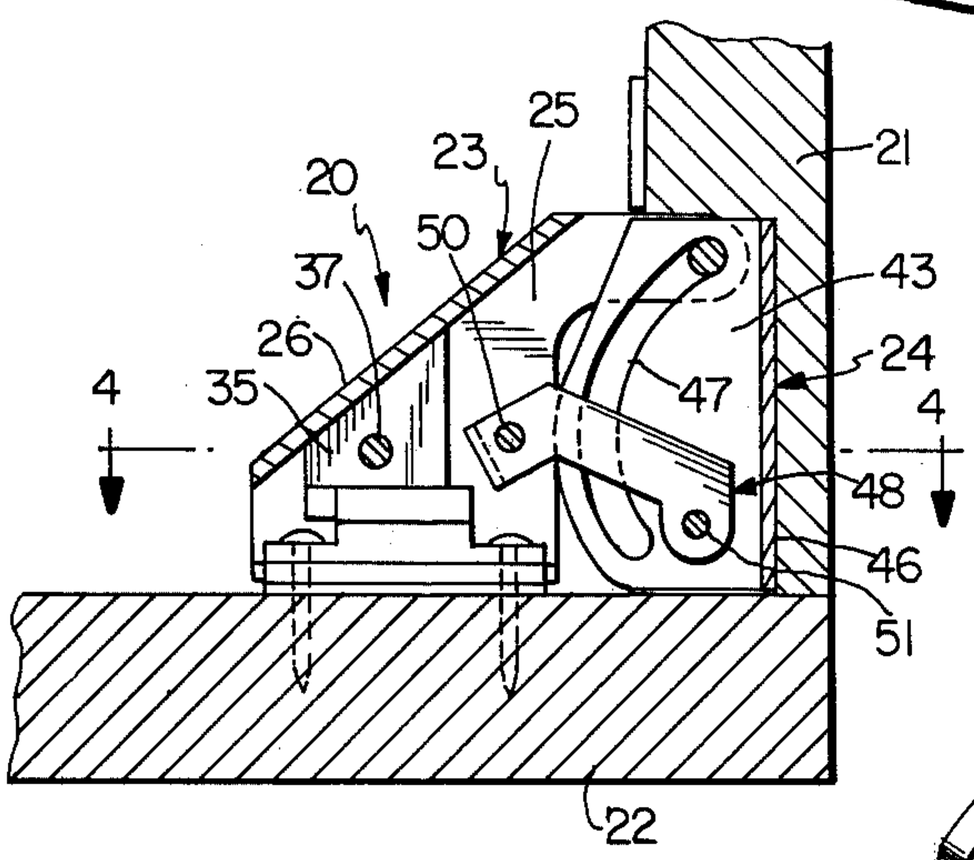


FIG. 3

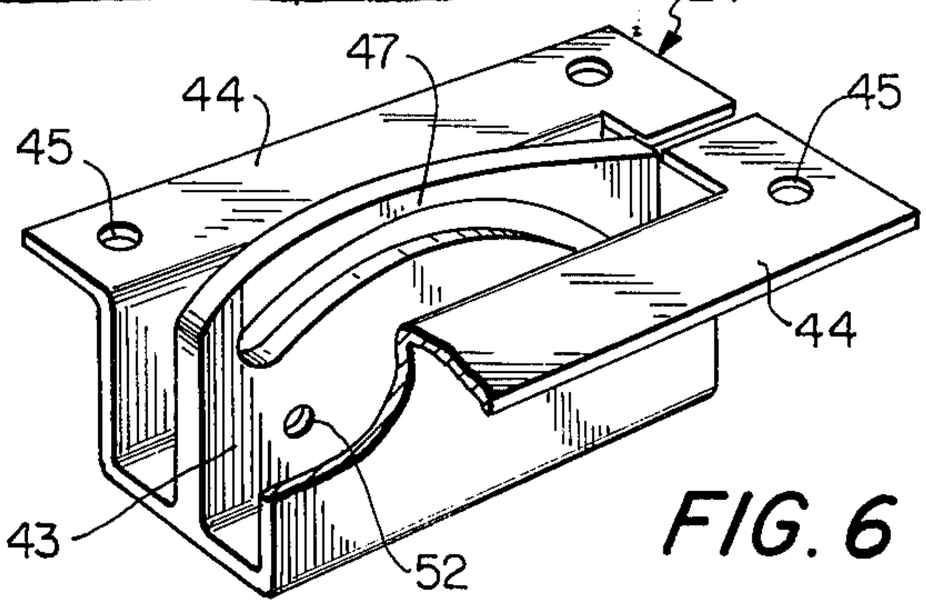


FIG. 6

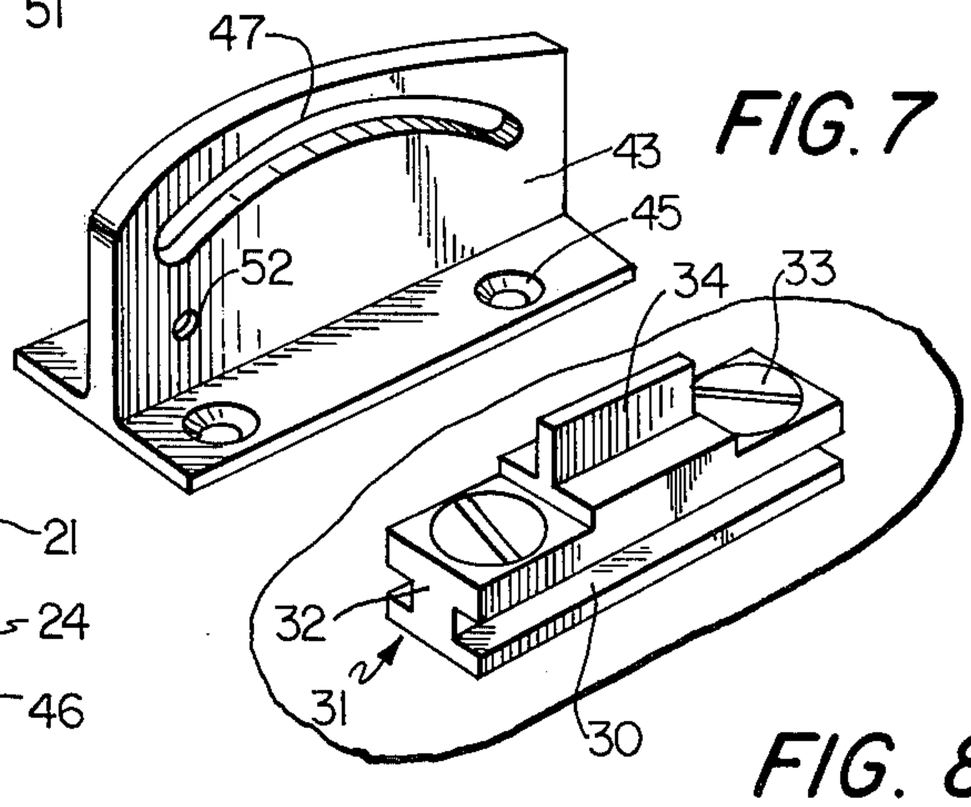


FIG. 7

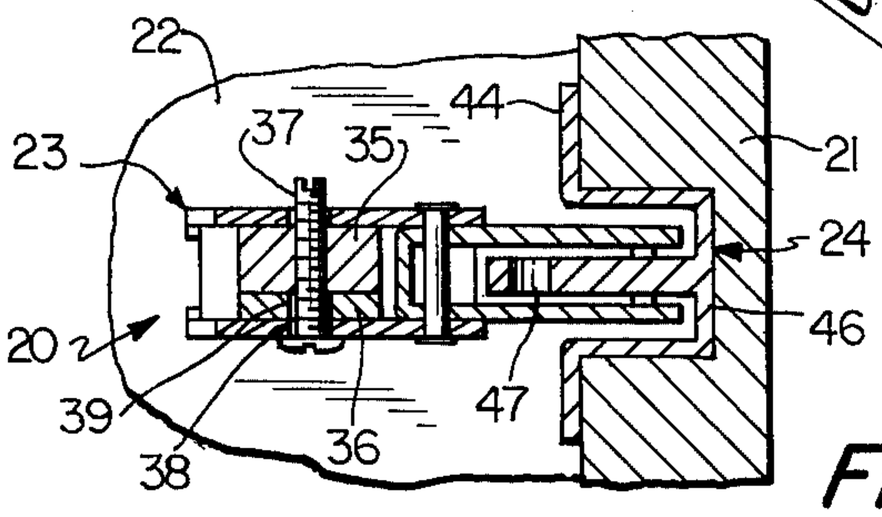


FIG. 4

FIG. 8

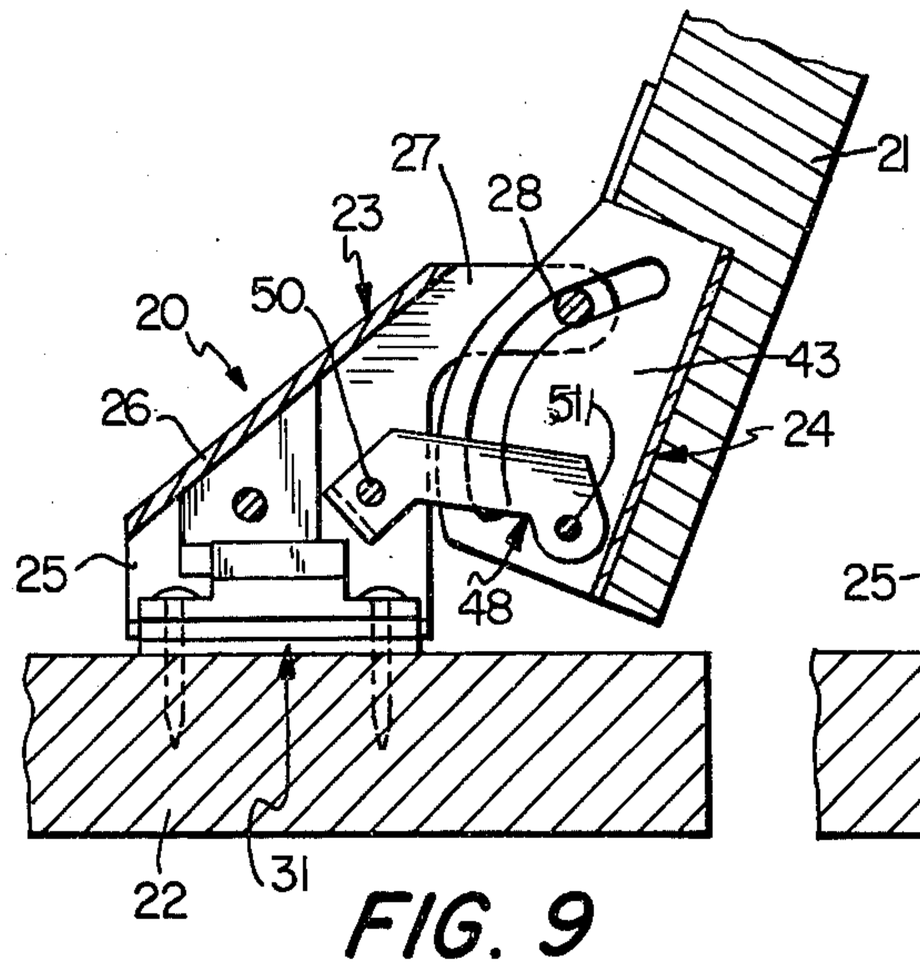


FIG. 9

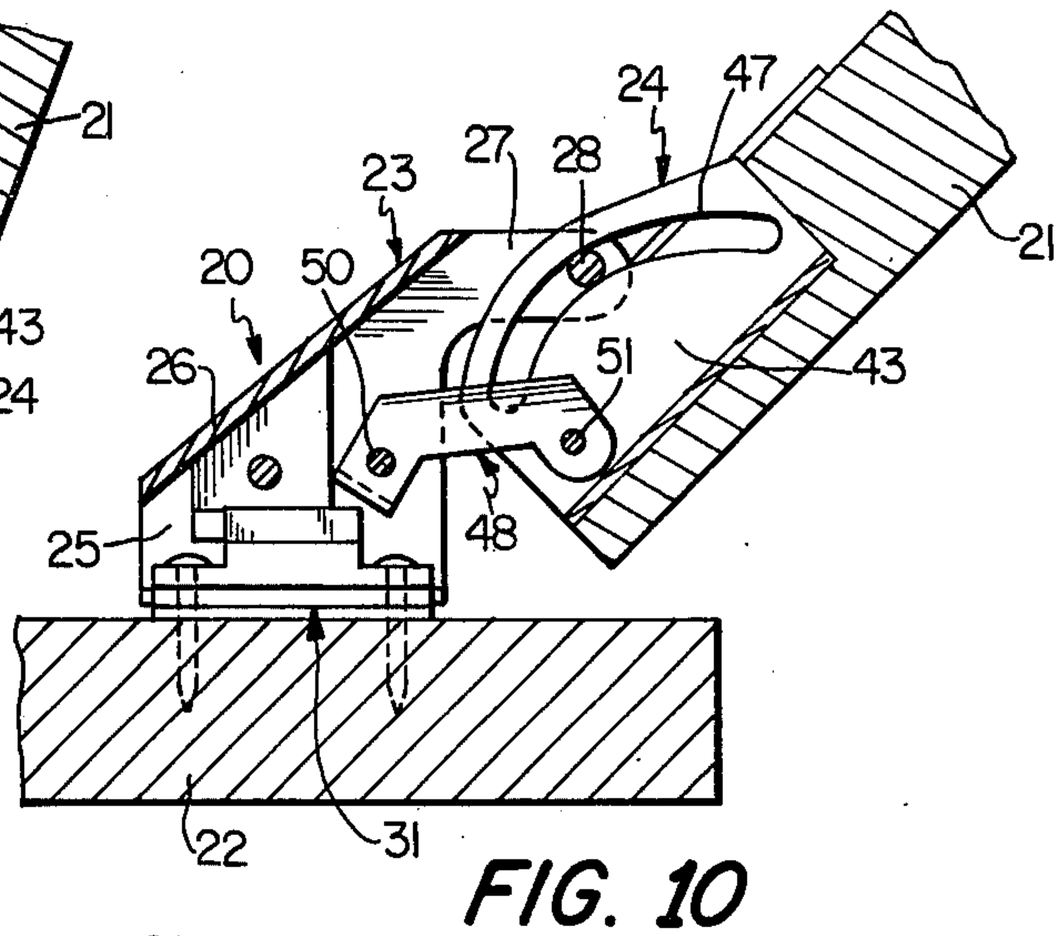


FIG. 10

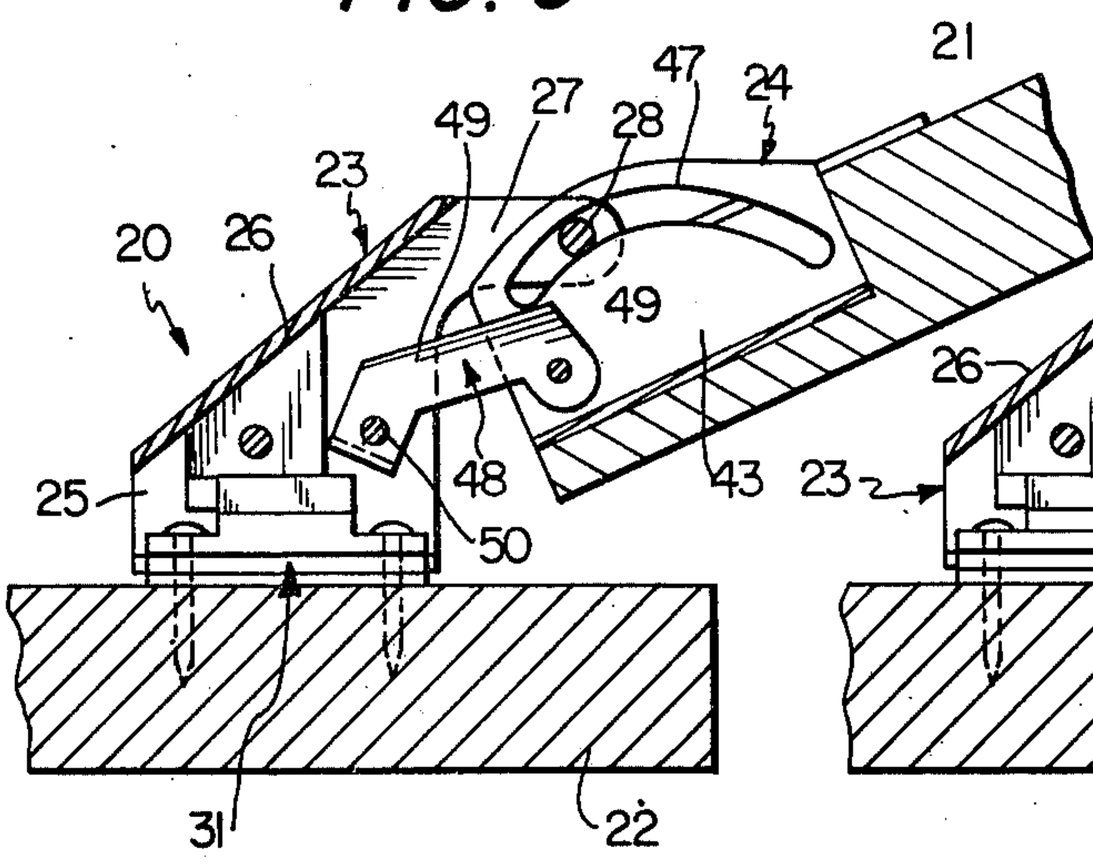


FIG. 11

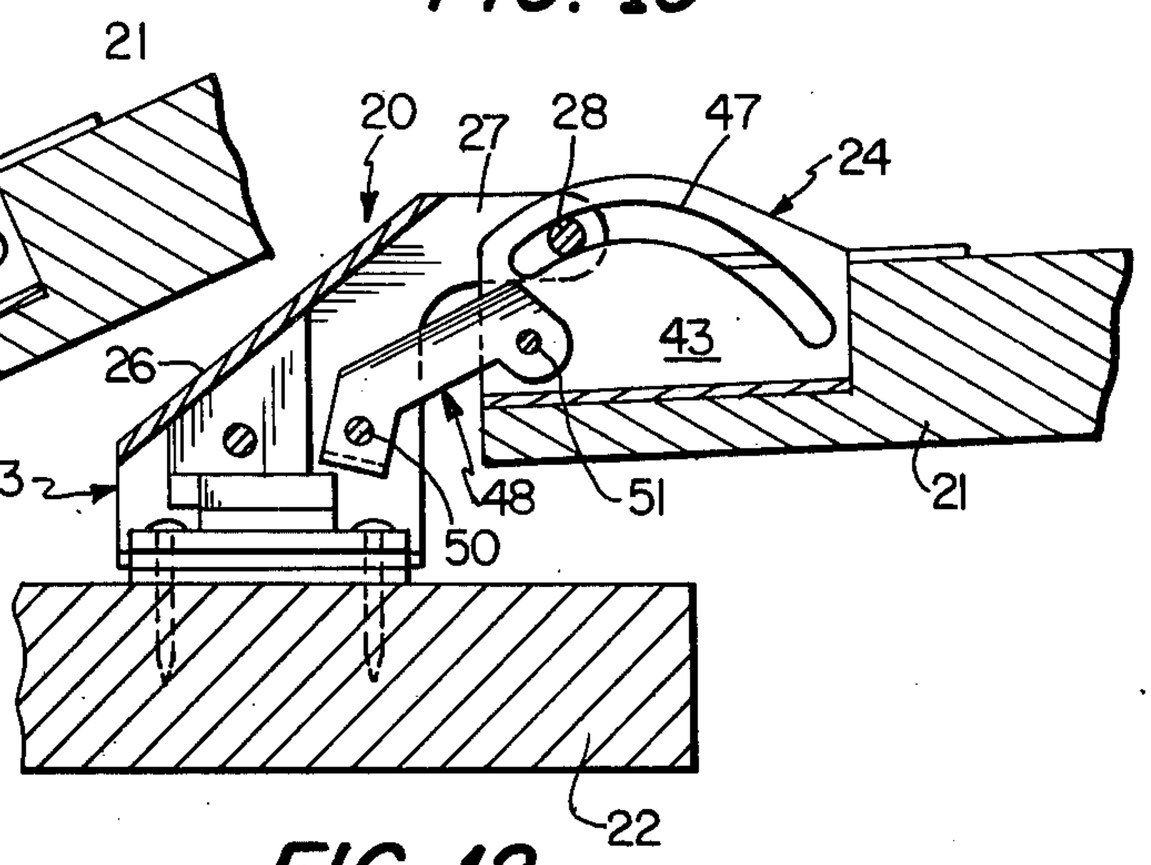


FIG. 12

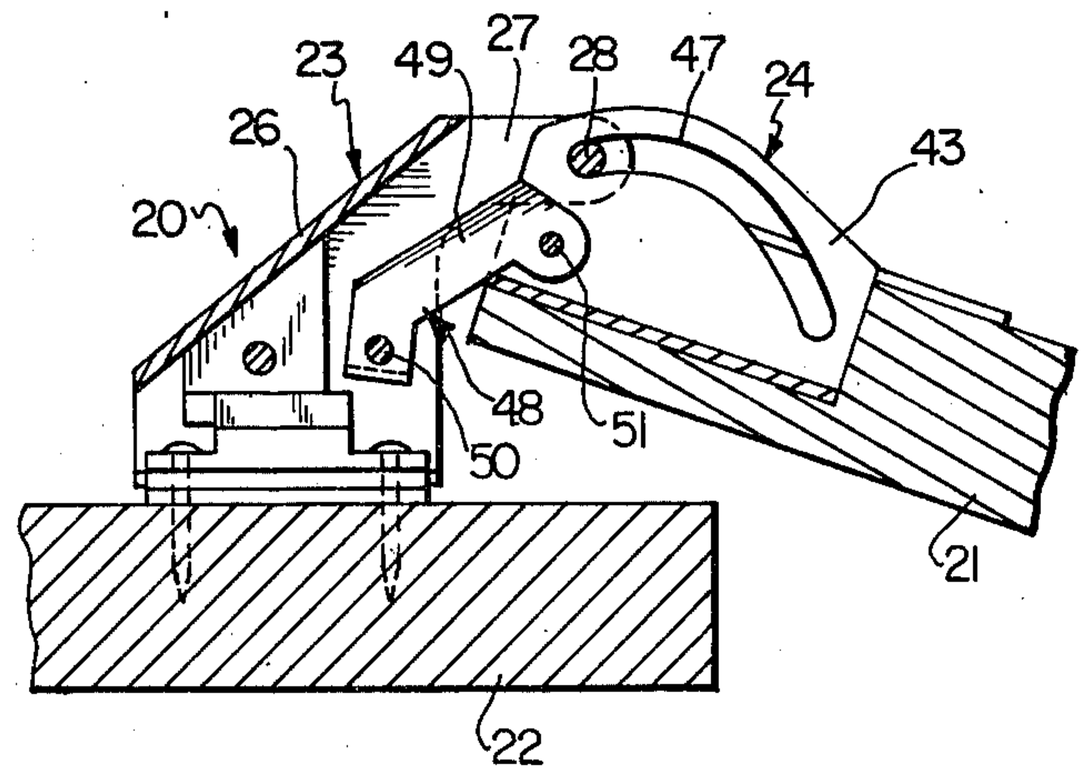


FIG. 13

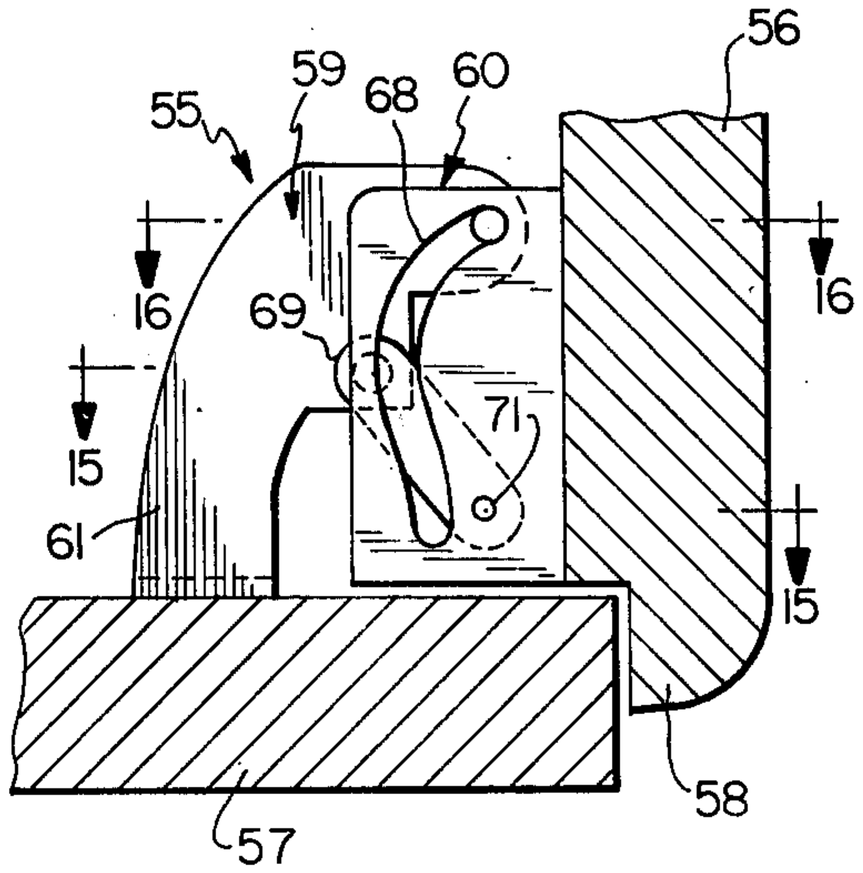


FIG. 14

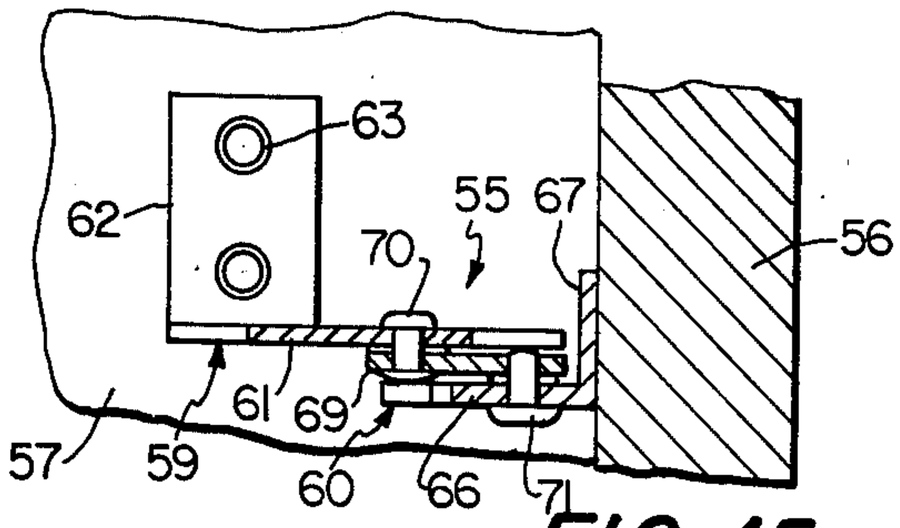


FIG. 15

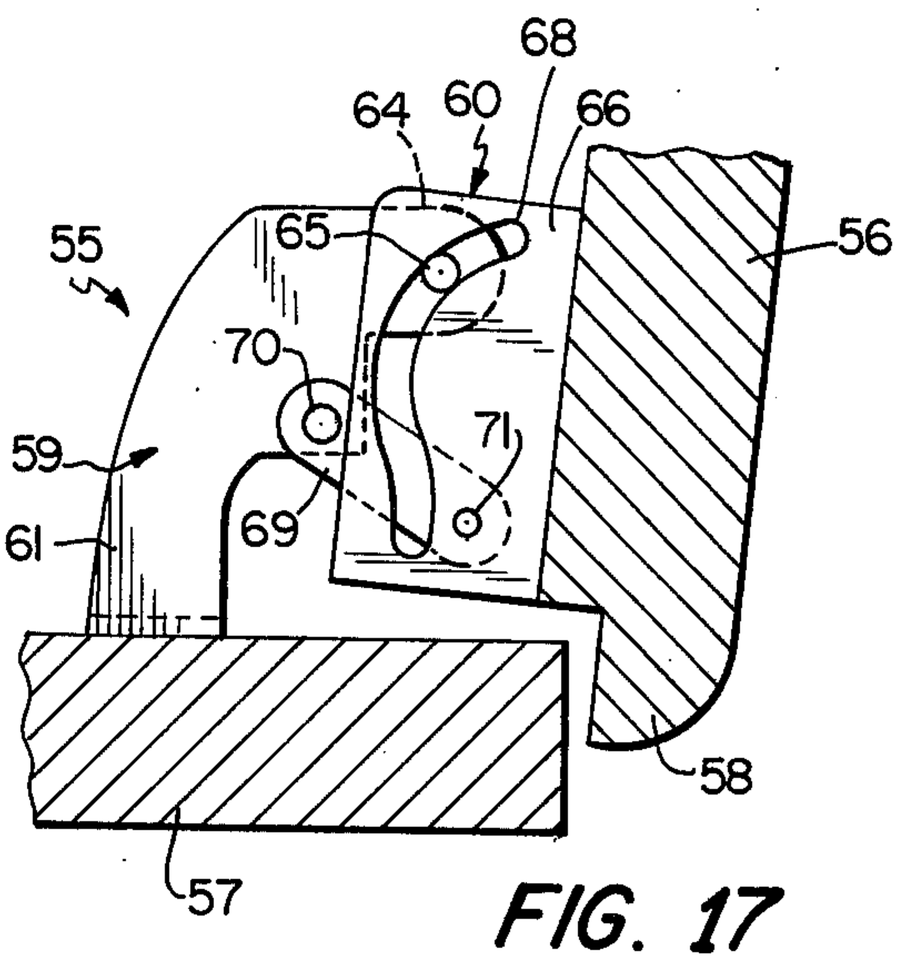


FIG. 17

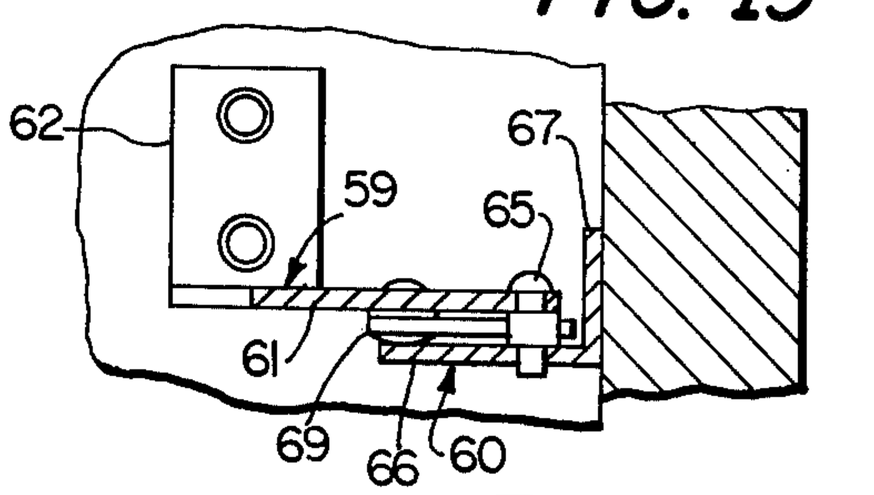


FIG. 16

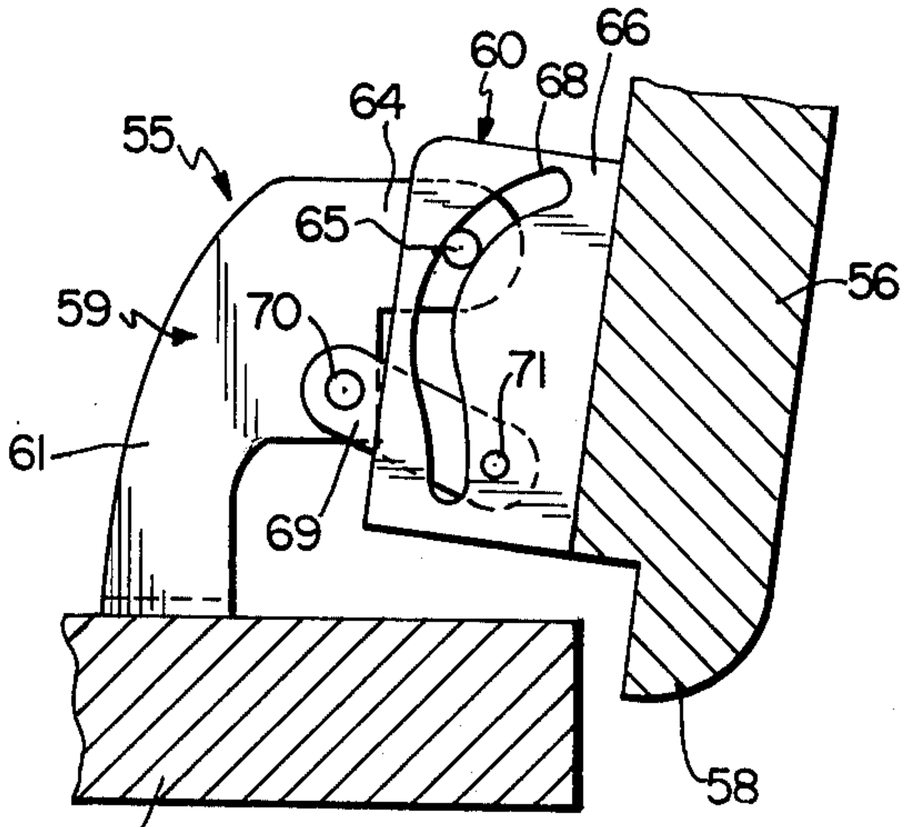


FIG. 18

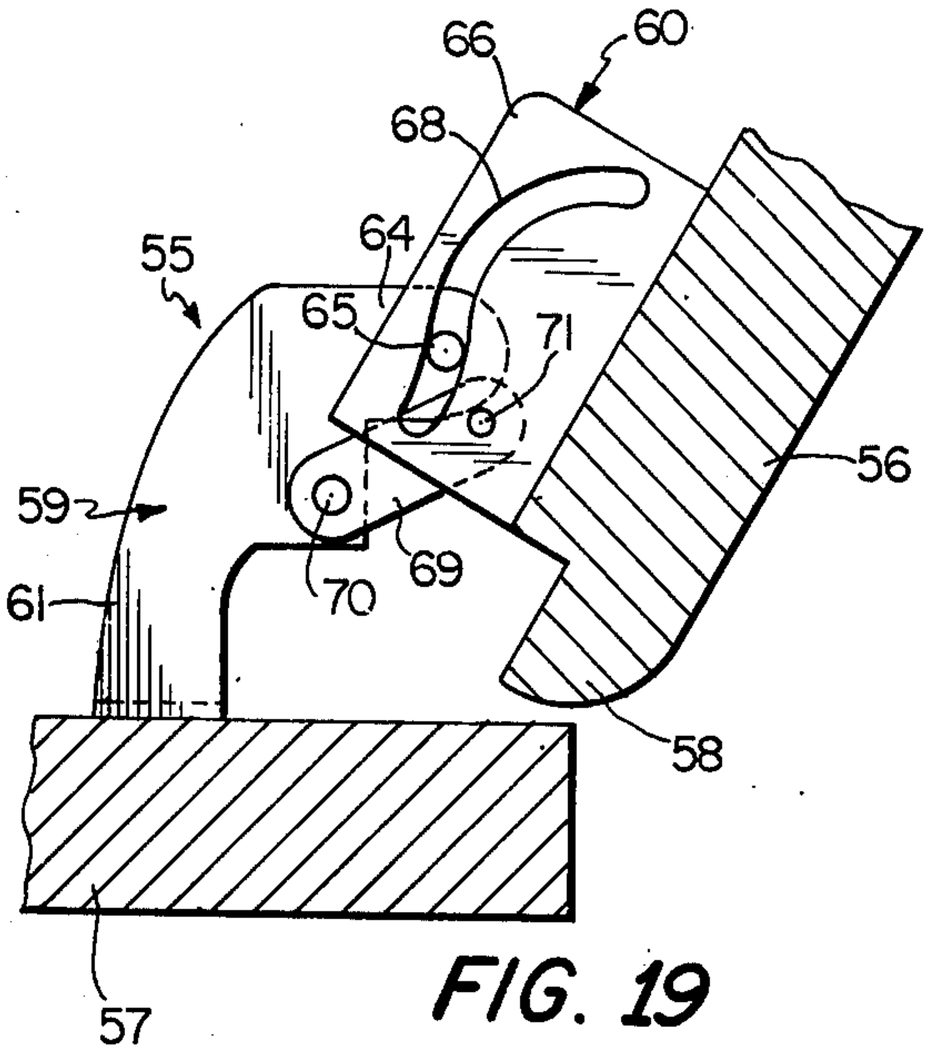


FIG. 19

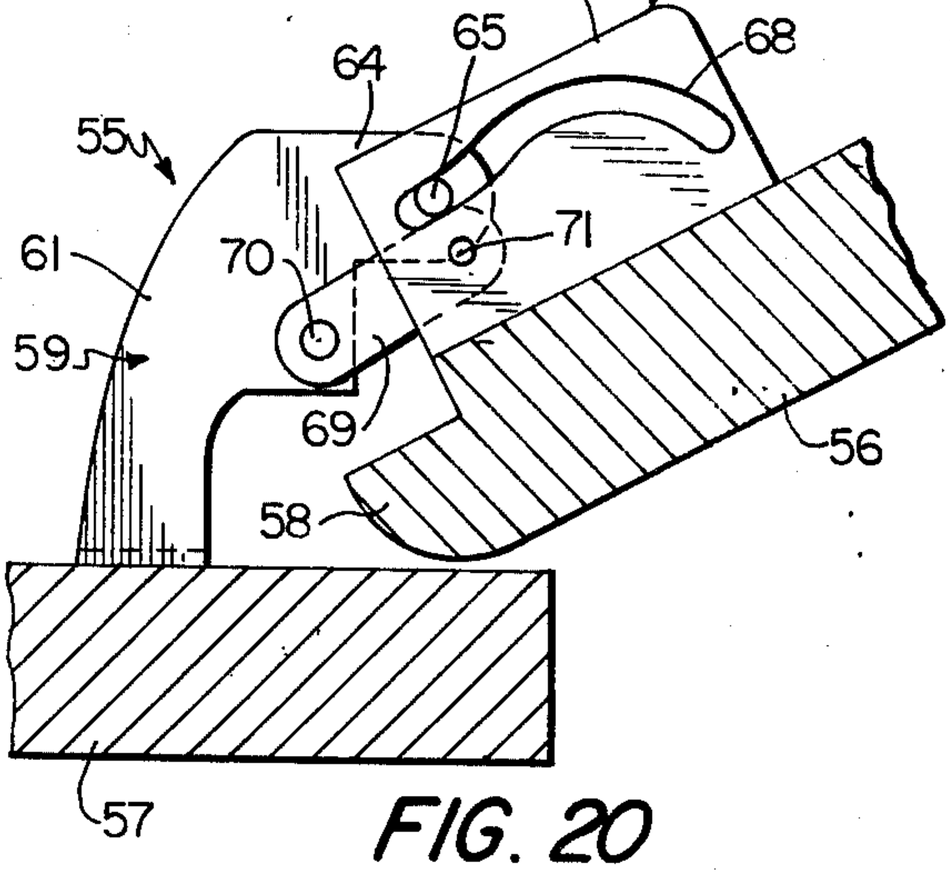


FIG. 20

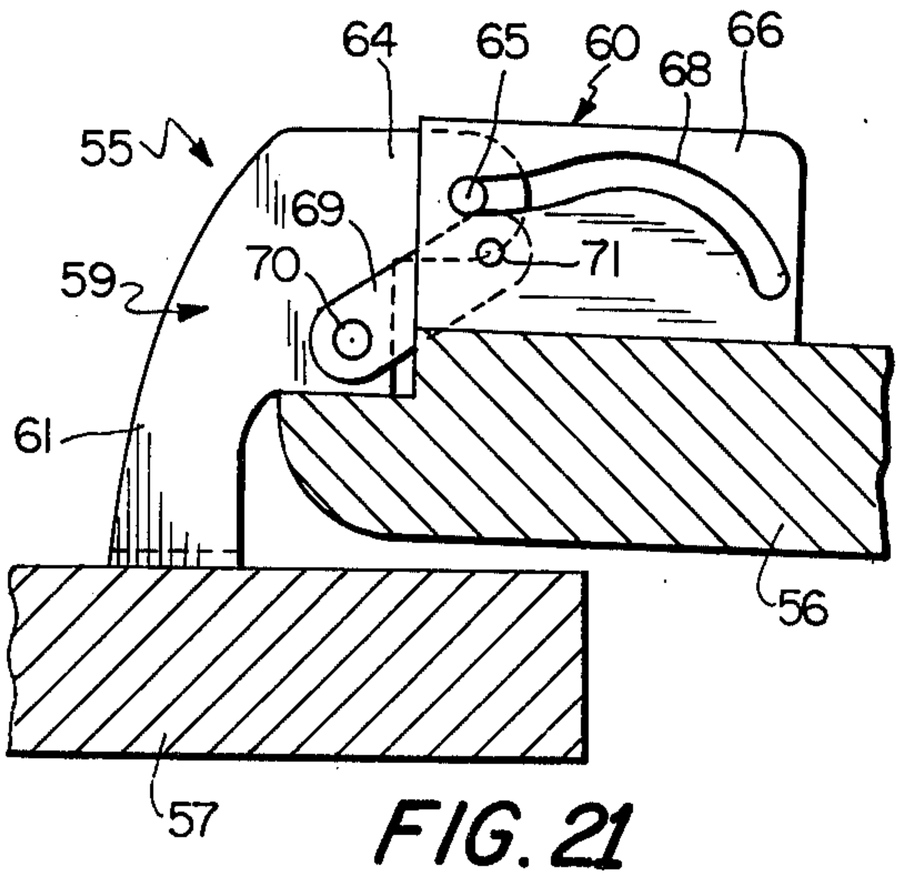


FIG. 21

FULLY CONCEALED DOOR HINGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to hinge members for swingably mounting a door on a fixed structure the plane of which normally is disposed at an angle to the plane of the door and relates particularly to hinge members for mounting doors and the like on furniture and cabinets in which such hinge members are fully concealed when the door is closed.

2. **Description of the Prior Art**

Heretofore, hinges of various kinds have been provided for swingably mounting one member on another in a manner to permit relative movement. Most hinges have been provided with a pair of leaves having one or more loops or eyes which receive a hinge pin to connect the leaves togther. Normally where doors are concerned, one leaf is mounted on a fixed structure, such as a door frame, and the other leaf is mounted on the trailing edge of the door, while the hinge pin is spaced outwardly from the fixed structure and the door so that the door may swing relative to the fixed structure without interference. With this type of hinge, portions of each of the leaves and the hinge pin are exposed to view on the side toward which the door opens and since substantially all doors of furniture and cabinets open outwardly to afford access to the interior, such hinge portions have been clearly visible.

Some efforts have been made to conceal the hinges by providing apparatus having multiple pivots connected together by linkages, however, these efforts generally have been only partially successful. Normally the prior art efforts have attempted to reposition a primary pivot by a series of sequential motions which locate the primary pivot in a position to permit free swinging movement of the door. These prior attempts have had limited success due to one or more of the following practical difficulties:

1. Loss of door control. In most hinge members having multiple pivot parts, when the primary pivot has reached the desired position, the door is permitted to freely swing about the primary pivot. In such cases the door is free to contact the material of the frame. Also a loss of control problem arises when the structure loses control of the sequence of motions. Thus the sequence of motions does not depend on the linkages but depends on the vectors of force which initiate the opening and closing of the door.

2. Extension of the linkages. Often, in order to achieve a desired path of movement of the door, it was necessary for the connecting linkages to be extended a relatively large distance from the support structure. This permitted normal operating stresses to damage the hinge and resulted in hinges which were larger, heavier, and stronger than should have been required.

3. Failure to be fully concealed. Most of the prior art structures were at least partially visible when the door was closed.

4. Extensive modification of door and frame structure. Extensive door and frame machining or other modifications of an unusual character or beyond the accuracy standards of the industry were frequently required.

Some examples of the prior art are U.S. Pat. Nos. 2,018,909 to Anderson; 2,062,840 to Soss; 2,248,972 to Dumelin; 3,231,928 and 3,626,548 to Grunert.

SUMMARY OF THE INVENTION

The present invention is embodied in a hinge structure for use with either an inset or overset door or other closure member in furniture, cabinets and the like and includes a pair of hinge members which are mounted on a door frame and a door and which are connected for relative movement by a linkage having a pair of pins or pivots. A portion of each of the hinge members is in overlapping relationship with a portion of the other hinge member and one of the hinge members is provided with a control slot while the other hinge member has a fixed member which is slidably received within the control slot. The connecting link and the control slot and fixed member cooperate in such a manner that the hinge controls the motion and positioning of the door at all times from fully closed to fully open positions, so that the door follows a selected rationally chosen path which remains the same each time the door is operated. The hinge members are easily and quickly attachable to the door frame and the door with little or no alteration of the frame and door structures and such hinge members are fully concealed when the door is closed.

It is an object of the invention to provide a relatively simple hinge for use with inset or overset doors of furniture, cabinets and the like in which the hinge is fully concealed when the door is closed an which controls the motion and positioning of the door when the door is opened.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of one embodiment of the present invention in use with an inset door.

FIG. **2** is a sectional view on the line **2—2** of FIG. **1**.

FIG. **3** is a sectional view on the line **3—3** of FIG. **2**.

FIG. **4** is a sectional view on the line **4—4** of FIG. **3**.

FIG. **5** is a section view similar to FIG. **2** and illustrating a modification thereof.

FIG. **6** is an enlarged perspective of the movable hinge member.

FIG. **7** is a perspective of another embodiment of the movable hinge member.

FIG. **8** is an enlarged perspective of a mounting member for the fixed hinge member.

FIGS. **9–13** are sectional views similar to FIG. **3** showing different positions of the hinge members while the inset door is being opened.

FIG. **14** is a top plan view of another embodiment of the invention in use with an overset door.

FIG. **15** is a sectional view on the line **15—15** of FIG. **14**.

FIG. **16** is a sectional view on the line **16—16** of FIG. **14**.

FIGS. **17–21** are plan views similar to FIG. **14** showing different positions of the hinge members while the overset door is being opened.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With continued reference to FIGS. **1–13** of the drawings, a hinge **20** is provided for mounting a door or other closure member **21** on a panel, frame, post or other fixed structure **22** of a cabinet or article of furniture. The invention is not limited to use with cabinets and furniture since it is contemplated that the hinge could be used to connect any relatively movable mem-

bers; however, it is particularly applicable to the cabinet and furniture industries.

The hinge **20** includes a first hinge member **23** which is mounted in fixed adjusted position on the panel **22** and a second hinge member **24** which is mounted on an inset door **21**. The first hinge member **23** includes a body which is generally U-shaped in cross-section and has substantially parallel side walls **25** connected by an inclined bight portion **26**. Substantially parallel outwardly extending lugs or ears **27** are provided at the upper ends of the side walls and such lugs are connected by a fixed member such as a guide pin **28** for a purpose which will be described later. The lower end of each of the side walls **25** is provided with an inwardly turned flange **29** and such flanges are slidably received within a pair of opposed slots or grooves **30** in a mounting member **31** (FIG. **8**).

The mounting member **31** includes a base **32** having openings at opposite ends for receiving conventional screws or other fasteners **33** by means of which the mounting member **31** is attached to the panel **22**. The slots or grooves **30** are located along opposite sides of the base **32** and extend the full length thereof. An upwardly extending web or sail **34** is disposed generally longitudinally of the central portion of the base **32**.

In order to attach the first hinge member **23** in fixed adjusted position on the mounting member **31**, a pair of clamping plates **35** and **36** are located within the body of the first member between the side walls **25** and each of such clamping plates has a portion located along opposite sides of the web or sail **34**. With particular reference to FIGS. **2** and **4**, a threaded screw **37** extends through openings **38** in each of the side walls **25**, through an opening **39** in the clamping plate **36** and threadedly engages the clamping plate **35**. When the screw **37** is loose, the first hinge member is freely slidable along the slots **30** and after the hinge member is in a desired position the screw is tightened to cause the clamping plate **35** to frictionally engage the web **34** and resist any additional movement so that the hinge member remains in fixed position.

Ordinarily, a pair of hinges are located along one side wall of a fixed structure and adjacent to the upper and lower surfaces of a cavity or compartment and such hinges are spaced a substantial distance from each other. The screw **37** of each hinge normally is in a generally vertical position and each screw has a head at one end with a screwdriver slot therein for receiving the blade of a conventional screwdriver. If the head of the screw **37** is located adjacent to the upper and lower surfaces of the compartment, it is difficult to apply a screwdriver blade to the screw slot and, accordingly, a second screwdriver slot is provided at the opposite end of the screw shank so that a screwdriver can be applied from either end of the screw.

With particular reference to FIG. **5**, a modified form of clamping arrangement is provided in which an opening **38'** is located in one of the side walls of the first hinge member and such opening is larger than the opening **38** in the other side wall and the opening **39** in the clamping plate **36**. A screw **37'** is provided having a shank with an enlargement **40** adjacent to the head which defines a shoulder for engaging the clamping plate **36** so that tightening the screw causes both clamping plates **35** and **36** to frictionally engage the web **34**.

As illustrated best in FIGS. **4** and **6**, the second hinge member **24** may be of a substantially square W cross-section having an upstanding central rib **43**. This type of hinge member is used with a relatively thick door and the upper ends of the side walls of the hinge member are provided with outwardly extending flanges **44**. Each of such flanges has openings **45** through which conventional screws or other fasteners extend to secure the hinge member **24** to the door. When this embodiment is to be used, a cooperating recess **46** (FIG. **4**) is provided in the structure of the door **21**. A portion of the longitudinally extending central rib **43** of the hinge member **24** is located adjacent to the lugs **27** and such rib is provided wtih an arcuate control slot **47** in which the guide pin **28** of the first hinge member **23** is slidably received. The shape of the arcuate control slot **47** is formed in any desired curvature in accordance with a selected path of movement of the hinged or trailing edge of the door **21**.

As illustrated in FIG. **7**, when the second hinge member **24** is to be used with a relatively thin door, such hinge member may have an inverted T-shaped cross-section with openings **45** spaced along the base portion thereof. In this embodiment, the second hinge member is mounted on the inner surface of the door **21** and the recess **46** is omitted.

A generally U-shaped connecting link **48** having elongated substantially parallel arms **49** is swingably mounted between the side walls **25** of the first hinge member **23** by a pivot pin **50** adjacent to the bight portion of the link. The arms **49** straddle the central rib **43** of the second hinge member **24** and are pivotally connected thereto by a pin **51** which passes through an opening **52** in such rib. In order to provide clearance when the door **21** is opened, the arms **49** of the link **48** may have a generally arcuate configuration, as illustrated in FIGS. **3** and **9–13**, or, if desired, such link arms could have an angular configuration similar to a bell crank. It is apparent that the first hinge member **23** is slidably connected to the second hinge member **24** by the pin **28** located within the control slot **47** and that one end of the link **48** is pivotally connected to the first hinge member by the pin **50** while the other end of such link is pivotally connected to the second hinge member by the pin **51**.

Relative movement between the arcuate control slot **47** and the associated guide pin **28** causes the link **48** to swing about the pins **50** and **51** and confines both the leading and trailing edges of the door **21** to rationally chosen desired paths. The shape of the arcuate control slot **47** ordinarily is determined by plotting a selected path for the trailing edge of the door and relating the necessary positions of the pins **50** and **51** and the link **48** to a set of coordinate points along the central rib **43**. Therefore, relative movement between the slot **47** and the guide pin **28** transmits the information contained in the bearing surfaces of the control slot to the pivot pins and link thus necessarily recreating the selected paths of movement of the leading and trailing edges of the door.

In order for the leading and trailing edges of the door to follow the same controlled path each time the door is moved, the guide pin **28** and the pivot pin **50** are spaced apart a fixed predetermined distance, the pivot pins **50** and **51** are spaced apart a fixed predetermined distance, and the distance between the guide pin **28** and the pivot pin **51** is variable. As a specific example, the distance between the guide pin **28** and the pivot pin **50** may be 1.063 inches (26.988 mm) and the distance between the pivot pins **50** and **51** may be 0.750 inches (19.050 mm).

In the example shown in FIGS. **3** and **9–13**, the control slot **47** has been plotted so that during the initial movement of the door the hinges cause the trailing edge

of the door to move out of abutting relationship with the panel **22** in a short motion which permits minimal clearance requirements between the door **21** and the panel **22**. The portion of the slot **47** which controls this motion, accelerates the door at a relatively low rate as a compromise between the desired clearing action and the maintenance of a normal "feel" to the door. Continued opening movement directs the trailing edge of the door away from the mounting panel and allows normal rotation of the leading edge of the door as the connecting link **48** pivots or swings about the pins **50** and **51** and the control slot **47** slides past the pin **28**. The final motion of the hinges directs the trailing edge of the door toward the hinges as the door passes 90° of the opening and terminates at a maximum open position at approximately 115° when the end of the slot **47** engages the pin **28**.

In the operation of this embodiment of the invention the second hinge member **24** is mounted within the recess **46** of the door **21** or on the inner surface thereof, depending upon the configuration of the hinge member and the particular door. The mounting member **31** is secured to the panel or post **22** in a desired position and thereafter the flanges **29** of the first hinge member **23** are inserted into the slots **30** after which the first hinge member is located in a desired position and the screw **37** or **37'** is tightened so that at least one of the clamping plates **35** or **36** intimately engages the web **34** to secure the first hinge member in fixed position. When the leading edge of the door which is opposite the hinges, is moved outwardly, as in opening the door, the control slot **47** is moved relative to the fixed guide pin **28** while simultaneously the connecting link **48** is pivoted about the pins **50** and **51**. Since the pins **28**, **50** and **51** are arranged in a generally triangular relationship with each other, the connecting link **48** and the control slot **47** control the motion and position of the door as the door is opened.

With particular reference to FIGS. **14–21**, a modified embodiment of the invention is provided including hinges **55** which are used for mounting an overset door **56** on a panel or post **57**. In this embodiment the door **56** includes a lip **58** which overlies opposite sides only of the opening in the panel **57** when the door is in closed position but does not overlie the top and bottom. Each of the hinges **55** includes a first hinge member **59** which is mounted on the panel **57** and a second hinge member **60** which is mounted on the door **56**. The first hinge member **59** includes a body **61** having an angularly disposed base **62** with openings **63** for receiving screws or other fasteners by which the first hinge member is secured to the panel **57**. The upper end of the first hinge member **59** terminates in a lug **64** having a pin **65** mounted thereon generally normal to the plane body **61**.

The second hinge member **60** includes a body **66** having a right angle flange **67** by means of which the second body is mounted on the door **56**. A portion of the body **66** is located adjacent to the lug **64** of the first hinge member **59**. The body **66** is provided with a control slot **68** which slidably receives the pin **65** when the door is moved relative to the panel **57**. A connecting link **69** is pivotally attached at one end to the body **61** by a pin **70** and is pivotally attached at the other end to the body **66** by a pin **71**.

In the operation of this embodiment of the invention, when the side of the door remote from the hinges is initially opened, the remote edge of the door accelerates while the control slot **68** moves past the pin **65** at a relatively low rate. Continued opening movement of the door causes the connecting link **69** to swing the body **66** outwardly so that the lip **58** moves along the edge of the panel **57** without contacting the same. The control slot **68** and the connecting link **69** continue to control the movement of the door so that when the lip **58** along the trailing edge of the door is disposed within the limits of the opening in the panel **57**, the control slot and the connecting link cause the trailing edge of the door to swing inwardly generally parallel with the inner surface of such panel. The inward movement of the trailing edge of the door continues while the door is being opened until the door is positioned at an angle of approximately 90° from its starting position at which time the pin **65** reaches the end of the control slot **68** and stops any further movement of the door.

I claim:

1. Hinge means for mounting a closure member on a fixed structure having an opening in a manner to entirely conceal the hinge means when the closure member is closed, comprising a first hinge member, means for adjustably mounting said first hinge member on one of said closure member and fixed structure including a base having at least one slot, said first hinge member having flange means slidably mounted in said slot, said base having an upstanding web extending lengthwise thereof, a clamping plate carried by said first hinge member, and means for moving said clamping plate into clamping engagement with said web to hold said first hinge member in fixed position relative to said base, a second hinge member fixed to the other of said closure member and fixed structure, guide pin means mounted on a portion of said first hinge member, a portion of said second hinge member being located adjacent to the portion of said first hinge member having said guide pin means, said portion of said second hinge member having a control slot which slidably receives said guide pin means, a connecting link means swingably connected at one end to said first hinge member and swingably connected at the other end to said second hinge member, said swingable connections of said connecting link being in spaced relationship with said guide pin means and said slot at all times so that said hinge means controls the motion of said closure member when said closure member is moved.

2. The structure of claim **1** in which said control slot and said cooperating link means are arranged in a manner to locate one side of said closure member within said fixed structure when said closure member is opened.

3. Hinge means for mounting a door on a fixed structure having an opening in a manner to entirely conceal the hinge means when the door closes the opening of said structure, said hinge means comprising a first hinge member, means for adjustably mounting said first hinge member on said fixed structure inwardly of said opening, including a base having longitudinally extending slots along opposite sides, said first hinge member having spaced generally parllel side walls with inwardly extending flanges adjustably received within the slots of said base, an upwardly extending web mounted on said base, at least one clamping plate located between said side walls, and means for selectively moving said clamping plate into clamping engagement with said web to hold said first hinge member in fixed adjusted position, said first hinge member having an outwardly extending portion with a guide pin mounted thereon, a

second hinge member, means for mounting said second hinge member in fixed position on said door, said second hinge member having an upstanding rib with an arcuate control slot therein, at least a portion of said rib being in side-by-side relationship with said outwardly extending portion of said first hinge member so that said guide pin is located within said control slot, a connecting link swingably connected at one end to said first hinge member and swingably connected at the other end to said second hinge member, said swingable connections of said connecting link being in spaced relationship with said guide pin and said control slot at all times so that said hinge means controls the motion of said door when said door is moved and positions at least a portion of the door within the opening of the fixed structure when the door is opened.

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